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| 10/814,768 | 03/31/2004 | Kazuhito Nakamura | RAJ-018 | 8865 |

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| EXAMINER | |
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| LAFOND, RONALD D | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/814,768 | NAKAMURA ET AL. | |
| | Examiner | Art Unit | |
| | Ronald D. Lafond | 1709 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *31 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-16 and 18-35* is/are pending in the application.

4a) Of the above claim(s) *2-6,19-22 and 33* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,7-16,18,23-32,34 and 35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03/31/2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *06/04/2004, 09/19/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Response to Amendment*

The Preliminary Amendment of January 27, 2006, was received and entered. Claims 13, 14, 18, 33, and 34 are acknowledged as amended, Claim 35 is acknowledged as new, and Claim 17 is acknowledged as canceled. This Action is in response to the amended Claims of this Application, in which Claims 1 – 16 and 18 – 35 are currently pending.

### *Election/Restrictions*

1. This Application contains claims directed to the following patentably distinct species:

   a. The embodiment wherein the heater is first exposed to a metal-containing gas, and subsequently exposed to only a non-metal containing gas to form a non-metal surface layer;

   b. The embodiment wherein the heater is first exposed to a metal-containing gas, and subsequently exposed to the metal-containing gas and a non-metal-containing gas simultaneously to form a combined metal/non-metal surface layer.

   c. The embodiment wherein the heater is first exposed to a metal-containing gas, subsequently exposed to the metal-containing gas and a non-metal-containing gas simultaneously to form a metal/non-metal intermediate layer, and finally exposed to the non-metal-containing gas only to form a non-metal surface layer.

   d. The embodiment wherein the heater is first exposed to a metal-containing gas, subsequently exposed to a first non-metal-containing gas only to form a non-metal intermediate layer, and finally exposed to a second non-metal-containing gas only to form a second and different non-metal surface layer.

   e. The embodiment wherein the heater is first exposed to a metal-containing gas, subsequently exposed to a metal-containing gas and a first non-metal-containing gas to form a metal/non-metal intermediate layer, and finally exposed to a second non-metal-containing gas only to form a non-metal surface layer.

f. The embodiment wherein the heater is first exposed to a metal-containing gas and a first non-metal-containing gas simultaneously, and subsequently exposed to a second non-metal-containing gas only to form a non-metal surface layer.

The species are independent or distinct because they are mutually exclusive.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, Claims 1, 12 – 16, 18, 23 – 31, and 35 are generic.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

2. During a telephone conversation with Kristi L. Davidson on April 19, 2007, and a subsequent message from Ms. Davidson left with the examiner on April 20, 2007, a provisional election was made without traverse to prosecute the invention of Species A, Claims 7 – 11, 32, and 34. Affirmation of this election must be made by applicant in replying to this Office action. Claims 2 – 6, 19 – 22, and 33 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

3. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the Application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

***Drawings***

4. The drawings are objected to because two figures are labeled as 6B. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the Application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an Application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 12, 13, 15, 16, 23 – 29, and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by Fukuda, et al (United States Patent Application Publication US 2001/0037769 A1, hereafter Fukuda).

7. Fukuda teaches, as in Claim 1, a method of processing a substrate (see Claim 1 of Fukuda, "A method for forming a thin film on a ... substrate") on a ceramic substrate heater in a process chamber (see Paragraph [0010] of Fukuda, "A ceramic heater has been proposed ... The ceramic heater also

serves as the susceptor for directly holding the semiconductor substrate"), the method comprising: forming a protective coating on the ceramic substrate heater in the process chamber prior to placing a substrate on the substrate heater (see Paragraph [0016] of Fukuda, "The present invention includes a method of using a ... CVD apparatus comprising a reaction chamber and a susceptor to form a thin film on a semiconductor substrate, wherein the method comprises a pretreatment step of forming a surface layer on the susceptor," Paragraph [0017] of Fukuda, "... and forming the surface layer on the surface of the susceptor by a CVD process", and Paragraph [0018] of Fukuda, "The pretreatment step may preferably be executed in the reaction chamber immediately before subjecting at least one semiconductor substrate to a film-forming treatment,"), including: a) exposing the ceramic substrate heater to a metal-containing gas to deposit the metal, and b) exposing the ceramic substrate heater to at least one non-metal-containing gas to deposit the at least one non-metal, wherein the protective coating comprises a surface portion for receiving a substrate, and wherein the surface portion is one of a combined metal/non-metal layer (see Paragraph [0034] of Fukuda, "In an embodiment, the pretreatment step includes steps of: introducing into the reaction chamber a gas ...; and forming the surface layer on the surface of the susceptor by a ... CVD process. ... These material gases are used to directly form the surface layer on the susceptor by a thin film-forming process using the ... CVD apparatus. The gas can be selected independently of subsequent film formation treatment, as long as a surface layer having the characteristics described below can be formed on the susceptor," and Paragraph [0035] of Fukuda, "Specifically, the surface layer is formed of ... a tungsten nitride film, ... a tantalum nitride film or another conductive film"); and processing at least one substrate on the coated ceramic substrate heater (see Paragraph [0031] of Fukuda, "The reaction gas is uniformly jetted toward the semiconductor substrate ... A chemical reaction occurs in the vicinity of the semiconductor substrate, and various thin films are formed").

8. Regarding Claim 12, Fukuda teaches the method according to Claim 1, wherein the ceramic substrate heater comprises at least one ceramic selected from the group consisting of AlN (see Paragraph [0010] of Fukuda, "A ceramic heater has been proposed. The heater is manufactured of ... aluminum nitride (AlN)").

9. Regarding Claim 13, Fukuda teaches the method according to Claim 1, wherein the metal of the protective coating comprises Tantalum (Ta), (see Paragraph [0035] of Fukuda, "The surface layer is formed of ... a tantalum nitride film").

10. Regarding Claims 15 and 16, Fukuda teaches the method according to claim 1, wherein the non-metal-containing gas comprises $N_2$ (see Paragraph [0045] of Fukuda).

11. Regarding Claims 23 and 24, Fukuda teaches the method according to Claim 1, wherein the forming further comprises heating the substrate heater to between about 300 and about 600 C (see Paragraph [0031] of Fukuda, "the susceptor ... is held at reaction temperature in a range of 300 C to 650 C). Because the range of 300 C to 650 C taught by Fukuda falls completely within the range of between about 100 C and about 800 C, as in Claim 23, and completely encompasses the range of between about 300 C and about 600 C, as in Claim 24, Fukuda anticipates both of these claims.

12. Regarding Claim 25, Fukuda teaches the method according to Claim 1, wherein the processing comprises providing a substrate to be processed on the coated ceramic substrate heater; performing a process on the substrate by exposing the substrate to a process gas; and removing the processed substrate from the process chamber (see Claim 1 of Fukuda, "A method for forming a thin film on a ... substrate ..., comprising ... forming by plasma reaction a thin film on a ... substrate placed on the susceptor having the surface layer, followed by unloading the treated semiconductor substrate from the reaction chamber").

13. Regarding Claims 26 and 27, Fukuda teaches the method according to Claim 25, further comprising forming a non-metal Si layer on the coated ceramic substrate heater following the removing, and repeating the processing at least once (see Claim 9 of Fukuda, "The method ... wherein the step of surface layer formation, the step of thin film formation ... are repeated in sequence," Paragraph [0034] of Fukuda, "The gas introduced into the reaction chamber need not be the same gas as that for use in film formation... The gas can be selected independently of subsequent film formation treatment," and Paragraph [0021] of Fukuda, "The surface layer may be formed of ... amorphous silicon, polysilicon").

14. Regarding Claim 28, Fukuda teaches the method according to Claim 25, wherein the performing comprises carrying out a PECVD process (see Claim 1 of Fukuda, "A method for forming a thin film on a

... substrate using a plasma CVD apparatus, comprising forming by plasma reaction a thin film on a ... substrate").

15. Regarding Claim 29, Fukuda teaches the method according to Claim 25, wherein the performing comprises depositing a metal layer on the substrate (see Paragraph [0034] of Fukuda, "The gas introduced into the reaction chamber need not be the same gas as that for use in film formation... The gas can be selected independently of subsequent film formation treatment," and Paragraph [0021] of Fukuda, "The ... layer may be formed of ... tungsten, ... tantalum").

16. Regarding Claim 31, Fukuda teaches the method according to Claim 1, further comprising cleaning the substrate heater and repeating the forming and processing (see Claim 9 of Fukuda, "The method ... wherein the step of surface layer formation, the step of thin film formation, and the step of reactor cleaning are repeated in sequence").

***Claim Rejections - 35 USC § 103***

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

18. This Application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

19. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda, and further in view of Ravi (United States Patent 5,952,060). Regarding Claim 30, Fukuda teaches the method

according to Claim 1, but does not teach the method further comprising repeating the forming and processing without cleaning the substrate heater. However, Ravi teaches just such a limitation, wherein a non-metal coating is re-applied between each substrate processing step (see Claims 25 and 27 of Ravi, "A method for processing substrates ..., said method comprising: coating at least a portion of said interior surface with a diamond coating ...; and thereafter, processing one or more substrates situated within said housing," and "The method ... wherein said coating step and said processing step are repeated iteratively"). Because Ravi discloses the advantages of maintaining a non-metal coating on the surface of parts that are exposed to reactants in substrate processing systems in order to "[reduce] the accumulation of residues and [reduce] the release of particulates and impurities during processing," (see Ravi Column 2, lines 29 – 31), it would have been obvious to one having ordinary skill in the art at the time this Application was filed to have modified the method taught by Fukuda with the method taught by Ravi (i.e., by instead re-coating the surface of the heater with the non-metal layer and then repeating the processing of substrates without an intermediate cleaning step) in order to gain these advantages and have fewer cleaning steps.

20. Claims 7, 8, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda, and further in view of Ohashi, et al (United States Patent Application Publication US2003/0064225 A1, hereafter Ohashi).

21. Regarding Claims 7 and 11, Fukuda does not teach the method wherein the protective coating comprises a non-metal layer surface portion and the exposing in (a) is performed first to form a first layer of the metal on the ceramic substrate heater, and the exposing in (b) is performed sequentially second to form the non-metal layer surface portion on the first metal layer, and wherein the non-metal layer surface portion is carbon (diamond). However, Ohashi teaches just such limitations, wherein a ceramic susceptor or heater (see Paragraph [0001] of Ohashi, "The present invention relates to a diamond-coated member mainly used for a substrate treating device ... More specifically, the present invention relates to a diamond-coated member which is preferably used particularly as a member in a reaction chamber where ... a silicon wafer is exposed to plasma – involving, for instance, ... a susceptor, ... a heater," Paragraph [0027] of Ohashi, "The present invention provides a diamond-coated ... member; comprising a basal

material and a thin film covering ... the surface of a basal material and being adhered thereto," and Paragraph [0033] of Ohashi, "Aluminum nitride ... may be preferably used [as the basal material]") is first coated with a thin metal film by CVD (see Paragraph [0034] of Ohashi, "Furthermore, it is preferable to include at least one kind of a metal material ... selected from the group consisting of ... tungsten and molybdenum, between the basal material and the thin film ... The intermediate layer may be formed by a well-known method, for instance, CVD"), and thereafter coated with carbon/diamond by CVD (see Paragraph [0071] of Ohashi, "it is preferable to provide the diamond thin film by CVD," and Paragraph [0114], "a ... diamond film was deposited by ... CVD using methane, hydrogen, oxygen as a starting gas"). Ohashi further teaches, in Paragraph [0025], that a diamond/tungsten coating sequentially deposited onto an aluminum nitride ceramic heater already "provides a diamond-coated member that is fully resistant against more corrosive gas, more powerful plasma or the like in a harsher corrosive atmosphere of a semiconductor producing process, and that prevents the generation of contaminants such as fine particles and metal ions. Furthermore, the member is applicable as a heater for heating a substrate." Because Ohashi teaches the use of the same type of ceramic heater and metal coating (tungsten) as taught by Fukuda, further comprising coating the tungsten with diamond, to achieve substantially the same advantages as the surface layer in Fukuda (see Paragraphs [0013] and [0014] of Fukuda) produces, it would have been obvious to one having ordinary skill in the art at the time the present Application was filed to have used the heater coating method disclosed by Ohashi, in which a non-metal diamond layer is deposited sequentially second to the deposition of a first metal layer on a ceramic heater, to modify the coating method taught by Fukuda with a reasonable expectation of success.

22. Regarding Claim 8, Fukuda in view of Ohashi does not explicitly teach the method wherein the surface portion of the protective coating includes a first surface portion for receiving a substrate and a second surface portion that remains exposed when the first surface portion receives a substrate, and wherein the processing includes placing the at least one substrate on the first surface portion of the non-metal layer surface portion of the protective coating and thereafter subjecting the substrate to a process during which a second layer of the metal is deposited on the second surface portion of the non-metal

layer surface portion. However, these claim limitations are inherent features of Fukuda and Ohashi, wherein a substrate is placed on the ceramic heater and treated with a metal film following the formation of a multi-layer tungsten/diamond film. Because Fukuda teaches, in Paragraph [0034], that "the [pretreatment] gas introduced into the reaction chamber need not be the same gas as that for use in film formation on the semiconductor substrate," and, in Paragraph [0021], that "the ... layer may be formed of ... tungsten, ... tantalum," it would have been obvious to one having ordinary skill in the art at the time the present Application was filed to have treated the substrate placed on the pre-coated ceramic heater formed by the method of Claim 7 with a metal (i.e. tungsten, tantalum) such that a second layer of the metal is deposited on the second surface portion of the non-metal layer surface portion.

23. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda in view of Ohashi, and further in view of Ravi.

24. Regarding Claim 9, Fukuda in view of Ohashi teaches the method according to Claim 8, further comprising: removing the processed substrate from the process chamber (see Claim 1 of Fukuda), but does not teach further exposing the coated ceramic substrate heater to the at least one non-metal-containing gas again to deposit an additional non-metal layer on the second metal layer and on the first surface portion of the non-metal layer surface portion. Regarding Claim 10, Fukuda in view of Ohashi does not teach this method further comprising repeating the processing, removing, and again exposing until a desired number of substrates have been processed. However, as discussed, Ravi teaches just such limitations, wherein a non-metal coating is re-applied to a substrate processing apparatus between each substrate processing step. Because Ravi discloses the advantages of maintaining a non-metal coating on the surface of parts that are exposed to reactants in substrate processing systems in order to "[reduce] the accumulation of residues and [reduce] the release of particulates and impurities during processing," (see Ravi Column 2, lines 29 – 31), it would have been obvious to one having ordinary skill in the art at the time this Application was filed to have modified the method taught by Fukuda in view of Ohashi in Claim 8 with the method taught by Ravi (i.e., by re-coating the surface of the ceramic substrate heater with the non-metal gaseous precursor initially used to form the non-metal surface portion of the substrate coating) in order to gain these advantages.

25. Claims 14 – 16, 18, and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda, in view of Vaartstra et al (United States Patent 6,197,628, hereafter Vaatrstra), and further in view of Nakajima (United States Patent 6,452,775).

26. Regarding Claim 14 – 16, Fukuda teaches the method according to Claim 1, but does not teach using a metal-containing gas that comprises at least one metal-carbonyl gas such as triruthenium dodecacarbonyl, $Ru_3(CO)_{12}$, and wherein the non-metal-containing gas comprises silane, $SiH_4$. Vaartstra teaches a method for forming a barrier layer, wherein $Ru_3(CO)_{12}$ (see Column 6, lines 28 – 31, "Most preferably, the ruthenium precursors used according to the present invention include ... triruthenium dodecacarbonyl") and $SiH_4$ (see Column 6, lines 33 – 36, "The silicon precursor is also provided to the reaction chamber. For example, the silicon precursor may include ... silane") are precursors in a method to form a RuSi barrier layer on a substrate (see Column 2, lines 45 – 46, "In another embodiment of the method, the barrier layer is formed by depositing $RuSi_x$ by chemical vapor deposition"). Vaartstra also teaches, in Column 1, lines 18 – 20, that "In many applications, it is preferable that the materials used provide effective diffusion barrier characteristics," and that, in Column 4, lines 9 – 15, "The structure is illustrative of the use of a $RuSi_x$ diffusion barrier layer for any application requiring an effective barrier layer. In other words, the $RuSi_x$ diffusion barrier layer may be used ... wherever it is necessary to prevent the diffusion of one material to an adjacent material." Nakajima teaches the use of a barrier layer deposited upon a ceramic coating (see Column 2, lines 39 – 41) of an electrostatic chuck used in a plasma etching apparatus (see Column 1, lines 5 – 9). Moreover, Nakajima teaches, in Column 2, lines 13 – 14, that "the present invention provides an electrostatic chuck having a high purity barrier layer," and, in Column 2, lines 46 – 48, that "the electrostatic chuck significantly reduces contamination of the backside of the semiconductor wafer." Applicants disclose, in Paragraph [0005], that "copper diffusion in silicon devices is a well-known backside diffusion problem, but other metals, for instance ruthenium (Ru), can also be fast diffusers in silicon." Because Nakajima teaches that barrier layers deposited via CVD on the surface of ceramic substrates that contact substrates in normal semiconductor substrate processing operations reduce backside contamination of said substrates, and because Vaartstra teaches that RuSi films formed via CVD from $Ru_3(CO)_{12}$ and $SiH_4$ precursors form effective diffusion barrier layers, it would

have been obvious to one having ordinary skill in the art at the time the present Application was filed to have modified the method taught by Fukuda by using the RuSi barrier layer and its gaseous precursors as taught by Vaartstra in view of Nakajima with a reasonable expectation of success.

27. Regarding Claims 35 and 18, as discussed, Fukuda teaches a method corresponding to Claim 1. Claim 35 differs from Claim 1 only in that it specifies that "wherein the metal-containing gas comprises a Ru-containing gas and the non-metal-containing gas comprises a silicon-containing gas," which Fukuda does not teach, and Claim 18 further specifies that the metal-containing gas comprises $Ru_3(CO)_{12}$ and the non-metal-containing gas comprises $SiH_4$. However, as discussed for Claims 14 – 16, Vaartstra teaches just such a combination of gases for the production a RuSi barrier layer, and Nakajima provides the necessary motivation to use such a RuSi barrier layer on the surface of a ceramic substrate holder in a substrate processing system.

28. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda, in view of Vaartstra and Nakajima, and further in view of Norman, et al (United States Patent 6,869,876, hereafter Norman). Fukuda in view of Vaartstra and Nakajima teaches (see analysis above for Claims 35 and 18 in Paragraphs 26 and 27) a method of processing a substrate on a ceramic substrate heater in a process chamber, the method comprising: a) forming a Si/Ru protective coating on the ceramic substrate heater in the process chamber, including: i) exposing the ceramic substrate heater to $Ru_3(CO)_{12}$ to deposit a Ru layer on the ceramic substrate heater, and ii) exposing the ceramic substrate heater to $SiH_4$ to deposit Si; b) processing at least one substrate on the coated ceramic substrate heater, including: i) providing a substrate to be processed on the coated ceramic substrate heater, ii) performing a deposition process on the substrate; and iii) removing the processed substrate from the process chamber. Fukuda in view of Vaartstra and Nakajima does not teach I) that the deposition process performed on the substrate in (b)(ii) is a Ru deposition process performed on the substrate by exposing the substrate to $Ru_3(CO)_{12}$; and II) that the exposing of the ceramic substrate heater to $SiH_4$ to deposit a Si layer in (a)(ii) is performed distinctly after the exposing of the ceramic substrate heater to $Ru_3(CO)_{12}$ to deposit Ru layer on the ceramic substrate heater, such that the Si layer is deposited on top of the Ru layer (and not in a combined layer). Regarding (I), as discussed, Vaartstra in view of Nakajima teaches that a combined

RuSi barrier layer may be used to coat a ceramic substrate heater. Fukuda teaches, in Paragraph [0034], that "The gas introduced into the reaction chamber need not be the same gas as that for use in film formation on the semiconductor substrate. The gas can be selected independently of subsequent film formation treatment, as long as a surface layer having the characteristics described ... can be formed." However, Fukuda also teaches, in Paragraph [0034], that "the same gas as that for use in the film-forming treatment on the semiconductor substrate [may be] used" for forming a surface layer on the ceramic substrate heater. Therefore, it would have been obvious to one having ordinary skill in the art at the time the present Application was filed to have treated the substrate as taught by Fukuda in view of Vaartstra and Nakajima with the metal gas, $Ru_3(CO)_{12}$, that comprises part of the surface layer formed on the ceramic substrate heater. Regarding (II), Vaartstra in view of Nakajima does not explicitly teach that a bilayer of Si on top of Ru, in which distinct, separate layers are formed, can successfully function as a barrier (surface) layer. However, Norman teaches, in Column 10, lines lines 4 –22, that "since the barrier materials also need to be grown very thin with high conformality, these layers are also preferably grown by ALD [Atomic Layer Deposition]. Typically, the barrier layer may be formed using tantalum (Ta). Suitable compounds used to form the barrier layer ... include ... tantalum nitride, ... silicide compounds comprised of the foregoing (e.g. TaSiN) ..." Because Norman teaches that the barrier layers taught by Fukuda, e.g. TaN, may successfully be formed by ALD, in which nitride is deposited after the deposition of tantalum, and because Norman also teaches that multi-layer silicide barrier layers may also successfully be used, it would have been obvious to one having ordinary skill in the art at the time the present Application was filed to have deposited the RuSi barrier layer taught by Fukuda in view of Vaartstra and Nakajima sequentially via ALD as taught by Norman with a reasonable expectation of success.

29. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda, in view of Vaartstra and Nakajima, further in view of Norman, and further in view of Ravi. Fukuda, in view of Vaartstra, Nakajima, and Norman teaches the method according to Claim 32, further comprising repeating the processing at least once. However, Fukuda in view of Vaartstra, Nakajima, and Norman does not teach the method further comprising forma a Si layer on the protective coating following the

removing. As discussed in Paragraph 18 above, Ravi teaches the limitation wherein a non-metal coating is re-applied between each substrate processing step. Because Ravi discloses the advantages of maintaining a non-metal coating on the surface of parts that are exposed to reactants in substrate processing systems, and because Norman teaches that multi-layer SiRu layers can successfully be employed as barrier layers, it would have been obvious to one having ordinary skill in the art at the time the present Application was filed to have formed another Si layer on the substrate heater in between processing steps with a reasonable expectation of success and to have obtained the benefits suggested by Ravi and Norman.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ronald D. Lafond whose telephone number is (571) 270-1878. The examiner can normally be reached on M-F 7:30-5:00 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on (571) 272-1418. The fax phone number for the organization where this Application or proceeding is assigned is 571-273-8300.

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